Joint Manipulation in the Management of Lateral Epicondylalgia: A Clinical Commentary

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Abstract: Lateral epicondylalgia or tennis elbow is a prevalent musculoskeletal disorder that is characterized by lateral elbow pain often associated with gripping tasks. The underlying pathology remains to be fully elucidated; however, evidence indicates that the disorder does not involve an inflammatory process but rather impairments of the pain and motor systems as well as morphological changes in the structure of both the extensor carpi radialis brevis muscle and tendon. Although the most efficient management approach remains controversial, there is a growing body of literature reporting the effects and underlying mechanisms of joint manipulation in the management of lateral epicondylalgia. Evidence exists demonstrating that joint manipulation directed at the elbow and wrist as well as at the cervical and thoracic spinal regions results in clinical alterations in pain and the motor system. In addition to presenting this evidence, this paper describes proposed underlying physiological mechanisms of joint manipulation associated with the observed clinical effects. We propose that this information will be useful for the physical therapist in making clinical decisions regarding the selection of treatment technique for the management of patients with lateral epicondylalgia.

Key words: Tennis Elbow, Joint Mobilization, Joint Manipulation, Manual Therapy

Lateral epicondylalgia (LE), epicondylitis, or tennis elbow is a musculoskeletal disorder often encountered by healthcare practitioners, such as physical therapists, and is characterized by pain over the lateral elbow that is typically aggravated by gripping activities[1]. The syndrome is most prevalent (35–64% of all cases) in jobs requiring repetitive manual tasks, it results in restricted function, and it is one of the more costly of all work-related illnesses[2-4]. The peak incidence of this condition occurs between the ages of 35 and 50 and usually affects the dominant arm[5].

Formerly called *lateral epicondylitis*, *lateral epicondylalgia* or *epicondylar tendinopathy* are more appropriate terms considering that numerous studies[6-9] have shown the absence of inflammatory cells in this disorder. It has, therefore, been suggested that the term *epicondylitis* be abandoned in favor of '*epicondylalgia*[1,10,11]. Recent evidence suggests that the symptoms associated with LE might be related to a constellation of changes in the extensor carpi radialis brevis and common extensor tendon mechanism. These have been reported to include signs of neurogenic involvement[12] as a result of chemical mediators of pain located in myelinated sensory fibers (e.g., substance P and calcitonin gene-related peptide)[12,13] and increased levels of glutamate (an excitatory amino acid)[14], neovascularisation[15], and changes in muscle fiber morphology (e.g., fiber necrosis, higher percentage of fast twitch oxidative fibers, and moth eaten fibers)[16]. Impairments in the sympathetic nervous system (e.g., absent vasomotor response)[17] and the presence of mechanical but not thermal hyperalgesia further point to the involvement of the pain and/or sensory systems in this condition[18,19].

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Currently, no general consensus exists as to the most appropriate management strategy for LE, even though several systematic reviews have been published. A review conducted by Bisset et al[20] identified evidence for the use of elbow manipulation[21,22] and therapeutic exercise[23] in the short term and recommended that the long-term effects of joint manipulation be studied. Other limitations with the current

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literature include poor methodological quality (i.e., lack of experimental rigor), a finding that has changed little since an earlier systematic review by Labelle[24].

Interestingly, in a recent commentary on management of LE, Ashe et al[25] listed a number of treatment approaches that included patient education, splinting, modalities (e.g., ice, LASER, and high-voltage galvanic stimulation), strengthening, and stretching. Noteworthy was the omission of joint manipulation from their list. Perhaps this may be related to the fact that LE has long been conceptualized as a musculotendinous disorder and the traditional focus of joint manipulation has been the direct influence upon joint structures rather than musculotendinous tissues[26].

Since the last clinical commentary on a manual therapist's perspective on LE[27], a significant number of studies[21,22,28-44] have investigated the effects of joint manipulation of the elbow and wrist as well as of the cervical and thoracic spines. The purpose of this paper is to comment on current research investigating the effects of joint manipulation, to elaborate on the hypothesized physiological mechanisms contributing to these clinical effects, and to present a clinical reasoning process to the technique selection that is based on the patient's clinical presentation. The commentary will provide clinicians with a rationale to refine decision-making regarding the incorporation of joint manipulation for the management of LE.

Manipulation of the Elbow

Mill's manipulation, which is reported to be in widespread use[45], is a small-amplitude high-velocity thrust performed at the end of elbow extension while the wrist and hand are held flexed[46]. It targets the common extensor tendon and is usually coupled with transverse friction massage with a view to freeing scar tissue. Stasinopoulos and Stasinopoulos[47] recently evaluated the clinical efficacy of this manipulation and friction massage compared to a supervised eccentric exercise program or treatment by polarized polychromatic non-coherent (Bioptron) light in 75 patients with tennis elbow. Their data showed that the manipulation/friction massage combination is no better than the Bioptron light, which are both substantially inferior to the exercise program. This finding is in line with that of a previous study[48].

One particular manipulative therapy technique that has been receiving considerable attention in the literature in the management of LE is Mulligan's Mobilization with Movement (MWM)[49]. The MWM technique is a non-thrust manipulative technique performed in the following fashion: The therapist first identifies a physical activity that the patient reports to be painful. Most often this entails the patient clenching the fist, a task that is frequently impaired in LE[26]. The patient is next instructed to perform the identified painful task while the therapist provides a laterally directed glide to the elbow (Figure 1). Preliminary findings have suggested that the orientation of the lateral glide and the amount of manual force applied by the therapist is critical to the effective application of this technique[29,33]. Directing the lateral glide force somewhat posterior or directly lateral is most effective[29]. A manual force of 1.9N/cm applied during the glide (standardized to the circumference of the patient's proximal forearm in cm), which was approximately two-thirds of the maximum force that the practitioner was willing to apply, has been shown to maximize the hypoalgesic effect[33]. The MWM is typically repeated for 6 to 10 repetitions per visit and then repeated over several follow-up sessions. Perhaps most critically, the MWM should be repeated as part of a home exercise program between physical therapy visits[26,29,49].

Several placebo-controlled studies[22,34] and a case-series[29] have demonstrated that a single application of the MWM for LE results in an immediate increase in pain-free grip force (strength). Pain-free grip force has been shown to be a valid and sensitive method of assessing clinically important change over time and correlates with the patient's perceived rating of change in those with LE[50]. These studies have also reported an initial reduction in pressure pain thresholds over the lateral epicondyle[22,34], improved range during upper limb neurodynamic testing (using the radial nerve bias test)[34], and sympathoexcitation[34] with the MWM technique.

Vicenzino and Wright[44] initially investigated the effects of a course of MWM treatments on the outcomes of pain and function in a patient with LE using a single-subject design.

Fig. 1: The lateral glide Mobilization With Movement treatment technique for lateral epicondylalgia being applied during the performance of a grip force test on a dynamometer.

The results were encouraging and demonstrated that the MWM technique, in addition to a self-MWM technique performed at home, resulted in rapid reduction in pain and the improved function that followed. In a quasi-randomized clinical trial, Kochar and Dogra[32] assigned 66 patients with LE to receive ultrasound and exercise therapy or ultrasound, exercise, and MWM for a period of 3 weeks. At the conclusion of treatment, the group receiving joint manipulation demonstrated a reduction in pain over the past 24 hours as measured by a visual analog scale score of 5.9 cm, which was significantly greater than the ultrasound and exercise group (1.7 cm). A 5.9 cm reduction in pain exceeds the clinically meaningful level of improvement in acute pain conditions by 4-fold[51-54]. The difference in pain scores between groups remained significant at the 12-week follow-up.

Recently, Bisset et al[55] studied the short-term (6 weeks) and long-term (3 to 12 months) effects of 8 sessions of MWM and exercise in a randomized clinical trial of 198 patients with LE. MWM and exercise was compared to a corticosteroid injection group and a group who followed a wait-and-see policy. There was a significant advantage of MWM and exercise over wait-and-see at 6 weeks with a Number Needed to Treat (NNT) of 3. That is, the practitioner would have to treat 3 patients with MWM and exercise in order to have one more successful outcome than if they advised the patient to adopt the wait and see approach. The NNT varied from 2 to 4 for MWM and exercise over injection in the long term. Over the entire 12-month period on an area-under-the-curve analysis (i.e., the product of outcome data by time over the entire 12 months), a blinded assessor judged the MWM and exercise to maximally reduce the severity of LE compared to the other treatments. Pain-free grip force was also optimally improved by MWM and exercises over the entire year. Patients in the MWM and exercise group were apparently more satisfied with their treatment since they sought out fewer other treatments. MWM and exercise also had significantly fewer recurrences (5/66) than did the injection group (47/65), which represents a 90% reduction in the risk of recurrence following corticosteroid injection. The relative risk reduction rate provides an estimate of the probability of a particular event (in this case recurrence of the condition) in one group divided by the probability of the same event in another group. In this case the relative risk reduction of recurrence was 90% for patients receiving MWM and exercise.

Manipulation of the Wrist

Preliminary evidence exists for the use of a scaphoid thrust manipulation technique in the treatment of LE. In a pilot study, Struijs et al[36] randomly assigned 31 patients with LE to receive either scaphoid thrust manipulation or a multimodal treatment approach consisting of ultrasound, friction massage, and strengthening exercises. All patients underwent 9 treatments over a 6-week period. At the termination of physical therapy, the group receiving scaphoid manipulation exhibited significantly less pain during the day measured by visual analogue scale. The success rates (i.e., the proportion of patients reporting complete recovery or much improvement) in the two groups were not significantly different (i.e., manipulation 85% versus comparison 67%), but this is possibly a type II error.

Manipulation of the Cervicothoracic Spine

Studies describing involvement of the cervicothoracic spine in patients with LE have either reported the prevalence of cervical spine impairments in patients with LE (mostly made as observations or comments in clinical trials), or have investigated the clinical effectiveness of spinal manipulation treatment[31,41,56,57]. In one of the first studies to consider addressing cervical spine impairments in patients with LE, Gunn and Milbrandt[31] treated 50 patients with a multimodal treatment package that included non-thrust manipulation and traction of the cervical spine, isometric neck exercises, and hot packs/ultrasound to the cervical spine, for an average period of 5.3 weeks. The results demonstrated that 86% (43/50) of patients reported a good (resuming previous occupation) or satisfactory (light duties or other occupation) improvement following treatment, which persisted at a 6-month follow-up. It should be recognized that all these patients exhibited recalcitrant LE, having failed other management approaches, even surgery in some cases. However, this study was not randomized, nor did it control for the possible natural history of the disorder, and thus it represents a low level of evidence.

More recently, in a pilot study by Cleland et al[58], 10 patients with LE were randomly assigned to receive treatment solely directed at the elbow or treatment directed at the elbow plus manipulation (non-thrust) of the cervicothoracic spine. All patients underwent 10 physical therapy sessions over 6 weeks, and the outcomes were captured at baseline as well as at 6 and 26 weeks. The results at discharge (6 weeks) showed improvements in pain-free grip force and on the Disability of the Arm, Shoulder, and Hand questionnaire but not on the pain rating scale; the results favored the group receiving the cervicothoracic spine manipulation. No inferential statistical analyses were performed as a result of the small sample size. Interestingly, a previous retrospective audit[30] of the outcome in 112 patients with LE revealed that the addition of spinal manipulation treatment (in 51 patients) resulted in significantly fewer visits ($P<0.01$), despite a similar success rate in both groups (80% and 75%). The spinal manipulation techniques directed at the cervical spine included passive physiological intervertebral mobilization techniques (80% of patients), MWM techniques (30% of patients), and muscle energy techniques (52% of patients). In contrast, Rompe et al[56] have shown that adding spinal manipulative therapy (passive mobilization therapy and traction of cervical and cervico-thoracic spine) to low-energy shock wave therapy did not alter the outcome of treatment[56]. However, the LE patients were not randomized to the manipulation group in that study[56]; therefore, it cannot be confidently stated that the spinal manipulation did not provide added benefit.

In a number of randomized control trials of the initial effects of neck manipulation (non-thrust) for LE, Vicenzino and colleagues[22,37-43] investigated the lateral cervical glide technique described by Elvey[59]. The technique is performed with the patient in supine and with the involved upper limb placed in a neurodynamic test position purported to preferentially stress or load the radial nerve[59,42]. With the arm in this position, the therapist applies lateral cervical glides at a frequency of 1.3HZ[42] at C5/C6 toward the contra-lateral side of symptoms (Figure 2). In an initial study[41], this technique was shown to result in an improved range of motion of the neurodynamic test, reductions in 24-hour pain on a visual analogue scale, and an increase in pressure pain thresholds (digital pressure algometry) to a significantly greater magnitude than the placebo group. In a follow-up study[38], the cervical lateral glide technique not only resulted in significant improvements in pressure pain threshold and increases in pain-free grip force, but it also produced a sympathoexcitatory response across sudomotor, cutaneous vasomotor, cardiac, and respiratory functions. It should be emphasized that, with the exception of the 24-hour follow-up for pain measures, both of the aforementioned studies only investigated effects immediately post-application of the cervical lateral glide techniques; therefore, long-term follow-ups are needed.

A noteworthy observation is that patients with LE who have concomitant cervical articular impairments or neck pain have a poorer prognosis. One reason for this is that the impairments and neck pain are often neglected in the treatment of a patient with LE[57,60]. Waugh et al[57] conducted a multi-center prospective cohort study of 83 patients with LE and reported that although the practitioners identified cervical impairment in 57% of patients, only 37% actually received treatment directed at the cervical spine[57]. Smidt et al[60] followed 349 patients from two randomized clinical trials[61,62] in order to better understand prognostic indicators of outcome; they found, that at the 12-month follow-up, one of the strongest contributors to persistent symptoms identified by the multivariate prediction model was concomitant neck pain. Interestingly, the patient's neck pain was not treated in these randomized clinical trials. The foregoing evidence highlights to practitioners that the cervicothoracic spine region should be considered in the clinical assessment and management of LE.

Fig. 2: The cervical spine lateral glide (oscillation at approximately 1.3Hz) applied to the C5/6 motion segment.

Physiological Rationale

While the true physiological effects of manipulative therapy may not yet be clearly elucidated, it is tempting to speculate on the physiological rationale as to why patients with LE respond favorably to such techniques directed at different anatomical regions. First, it is speculated that the pain associated with LE might be associated with altered neuronal afferent input to the spine[19,63]. Perhaps applying manipulation techniques to the elbow, wrist, and cervicothoracic spine may assist in reducing abnormal afferent input[64], resulting in a reduction of the symptoms associated with LE.

A number of double-blind, placebo-controlled, repeated-measures studies[34,37-40,65-68] have assessed sympathetic nervous system activity in an attempt to quantify the physiological effects of spinal and extremity manipulation techniques. Many of these studies[34,38,68] have demonstrated that spinal manipulation produces a statistically significant hypoalgesic effect and a concomitant sympathoexcitatory response when compared to a placebo or control group. Interestingly, there was a strong association between the hypoalgesic and sympathoexcitatory effects, with a confirmatory factor analysis correlation of 0.82 ($P=0.05$)[38]. A similar response has also been demonstrated with MWM of the elbow joint[35]. In a number of follow-up studies, which used methods to discern involvement of endogenous opioids, such as naloxone blockade and tolerance[34,35,43,69,70], the hypoalgesic effect was found to be non-opioid in nature. Subsequently, an animal study of knee manipulation for capsaicin-induced foot hyperalgesia reported that the substrates of the hypoalgesic effect were non-opioid in nature, involving both serotonergic- and noradrenergic-mediated descending pain inhibition pathways[71]. This was further supported by the finding that spinal gamma-aminobutyric acid receptors were not involved in the hypoalgesia[71]. The evidence of a concomitant effect[38] and the data from the animal study[71] provide a reasonable level of support for the dorsal periaquaductal gray area of the midbrain as a coordinating center for the manipulation-induced pain-relieving effects and for the idea that the studied techniques constitute an adequate stimulus for a non-opioid, endogenous descending pain inhibition system[69].

The notion that there exists only one physiological mechanism for manipulative therapy is improbable; the most reasonable explanation is that joint manipulation techniques result in a complex multi-system physiological response[69,72,73]. In support of this statement, Abbot et al[28] in a single-group repeated-measures design, showed that an MWM applied to the elbow in patients with LE resulted in a significant increase of shoulder external rotation immediately following the procedure, inferring that the treatment has also a somewhat distributed neuro-motor effect. Application of the MWM technique to the unaffected elbow of sufferers of unilateral LE resulted in a small reduction in grip strength[22,29], implying that the effect on the neuro-motor system is not present in pain-free elbows and that it may not be, as proposed by Slater et al[72], a post-exercise motor facilitation in response to the repeated muscle contractions performed during the MWM treatment. Further research is required to explore the significance of these initial findings in terms of the underlying mechanism of joint manipulation.

Using Pain System Impairments in Manipulation Technique Selection

Regardless of the fact that the theoretical constructs underlying manipulative therapy are not yet clearly understood, the evidence of benefit in the use of these techniques continues to expand. The question then arises as to when should various manipulative techniques be directed at the elbow and when should they be directed at the cervicothoracic spine? We speculate that possible subgroups of patients with homogenous clinical presentations may exist, who will respond differently to various forms of manipulative therapy. Under this schema, the practitioner has essentially three choices when incorporating manipulative therapy into the management of LE: peripheral (elbow ± wrist), spinal (cervical, thoracic), or a combination of both peripheral and spinal manipulations. Based on current evidence and clinical observation, we speculate that LE patients can be classified into different subgroups, which will determine their response to each of the manipulations.

The first classification is those patients who are likely to respond positively to peripheral treatments. We propose that patients exhibiting greater affected to unaffected side-to-side deficits in pain-free grip force relative to pressure pain thresholds are candidates for the MWM technique directed at the elbow[22,26,74]. This is based on studies that showed that the effects of the MWM technique[22,34] produced a much greater improvement in pain-free grip force relative to pressure pain thresholds. Vicenzino et al[34] demonstrated that the MWM technique resulted in a increase in pain-free grip force of 58% compared to an increase in pressure pain threshold of only 10%. Similarly, in a study by Paungmali et al[34], patients who were treated with the MWM technique experienced a 47% increase in pain-free grip force following the treatment while the pressure pain threshold only exhibited a 9% change.

The second classification is patients who are likely to respond to a cervical lateral glide manipulation. Vicenzino et al[38] demonstrated that patients receiving this treatment exhibited an improvement in pressure pain threshold of 29% while pain-free grip force only improved to a magnitude of 11%. Perhaps patients presenting with greater pressure pain threshold deficits relative to pain-free grip force deficits should first be treated with manipulative therapy techniques directed at the cervical spine.

The third classification of patients would be those who exhibit similar deficits in both pressure pain threshold and pain-free grip force and who might require treatment directed at both the peripheral and spinal joints. In this case continued re-examination would be especially warranted to ascertain if one treatment should take precedence over another[26]. Clearly, this classification system is in its infancy and must be investigated further prior to widespread clinical implementation.

Future Research

Future research studies should further investigate the long-term effects of manipulative therapy techniques directed at the spine as well as at the periphery. In addition, these studies should incorporate exercises that have shown to be beneficial and may serve to augment the rehabilitation process[23]. Future studies should identify predictor variables identifying which patients are most likely to respond rapidly and favorably to joint manipulation techniques directed to either the peripheral or spinal joints. In addition, only one of the studies[36] reported in this commentary used any form of high-velocity techniques with purported effects at the joint and was solely directed at the wrist. Future studies should compare the outcomes associated with thrust techniques directed at the elbow and cervicothoracic spine.

Conclusion

The literature, and in particular that reporting research of joint manipulation techniques in LE, has greatly increased over the 20 years. This growth in the literature provides an opportunity for practitioners to base clinical decisions on data that is more advanced in its inferential capabilities. For example, practitioners may approach the application of joint manipulations to the spine and peripheral joints with greater confidence of at least deriving short-term effects in pain-free grip force and pressure pain thresholds. The physiological rationale for these effects has also progressed and can now be more plausibly used in explaining clinically observable effects. Despite these advances, there remains much to be studied before there is solid evidence to support the use of joint manipulations in the treatment of LE. Until such data becomes available, we propose that practitioners base clinical decisions on a sound clinical examination and evidence from the literature as presented herein. ■

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